
PowerWorks™
Microturbine Systems

The rugged PowerWorks microturbine offers many facilities a new and efficient technology for economically generating on-site electricity and useful heat energy while operating on natural gas and producing very low emissions. PowerWorks is suitable for indoor installation and connects directly to the electrical distribution system of a facility.

The clean and reliable 70 kW output of the generator can offset higher-cost utility power 24 hours a day or just during peak-demand periods when electric rates increase. Heat energy recovered from the microturbine exhaust can efficiently supply a facility with domestic hot water, space heating, manufacturing-process heat, or heat to drive a chiller, a desiccant dryer, or some other thermal load. When used for cogeneration of both electricity and heat, efficiency and energy savings are particularly high.

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Big Energy Savings in a Small Package

Savings opportunities emerge in a deregulated industry

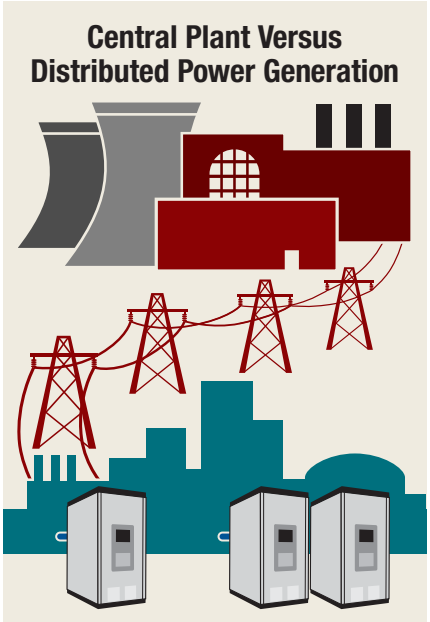
The deregulation of electric utilities has created new opportunities for commercial and industrial energy consumers to generate clean, reliable, and economical power on site at the point of use. This shift from large, centralized power plants to small, independent, and economical microturbine generators now affords many businesses greater control over the cost and quality of their power supply. On-site microturbine power is especially suited for the energy loads of manufacturing and commercial facilities, hotels, schools, hospitals, office buildings, multifamily dwellings, and other facilities that can benefit from a cost-effective and independent source of power and heat.

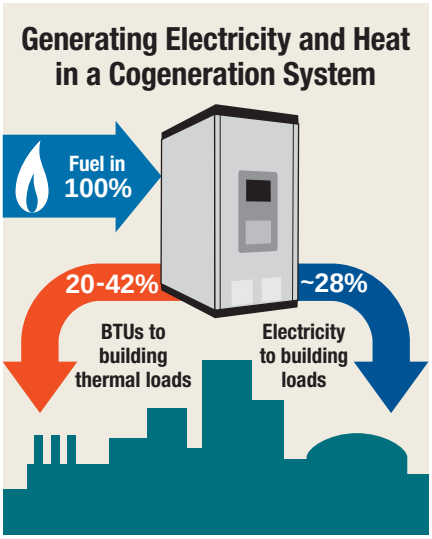
Microturbines offer facilities a new way of saving money

A microturbine is a small gas-turbine engine that drives a generator. Although similar in function to more complex gensets (reciprocating-engine-driven generators) in that they both provide power directly to a facility's electrical distribution system, a microturbine offers much better reliability, significantly longer service intervals, greatly reduced maintenance, a lower installation cost, lower emissions, lower noise levels, and a longer life. The microturbine is also designed for generating power continuously and very economically to reduce electricity costs, or it can be operated selectively for peak shaving during times when utility-grid costs are the highest. And these benefits are further enhanced by the economics of using the microturbine's waste heat for various hot water needs and other heating applications.

The PowerWorks microturbine system is exceptional

The new PowerWorks microturbine demonstrates a significant breakthrough in power efficiency, endurance, system versatility, and compact design. The patented technologies of the PowerWorks recuperator and combustor contribute to the highest fuel savings and longest life offered by any microturbine power system available. PowerWorks is also relatively quiet (compared to reciprocating-engine generators) while emitting extremely low NOx and CO emissions, has a small footprint, and can be installed either inside or near a facility.

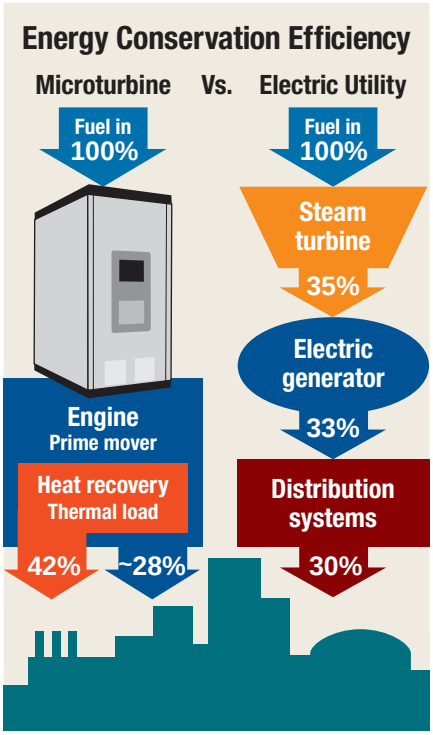




The unique two-shaft design of the PowerWorks engine plus the world's most advanced engine recuperator contribute to the system's reliability and long life. Output of the generator and the integrated heat-recovery system contribute to saving energy resources.

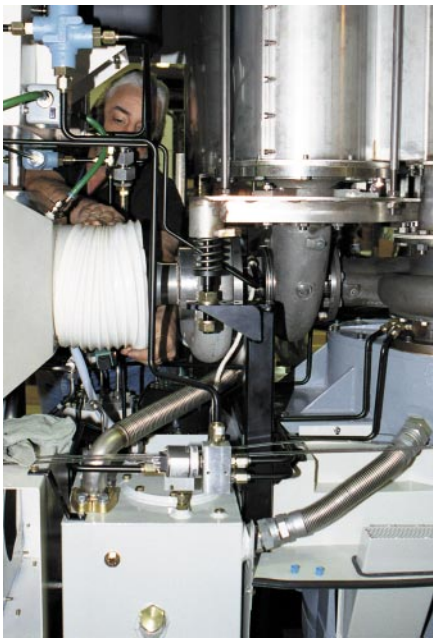
Heat recovery saves even more energy-cost dollars

In addition to generating electricity for base consumption or peak shaving, the thermal energy remaining in the microturbine exhaust can help heat a facility, provide domestic hot water, drive an absorption chiller, or regenerate a desiccant dehumidifier. The extremely clean exhaust of the PowerWorks microturbine can also be used directly in many industrial processes. By generating electric power where it is needed and effectively recovering the waste heat to defer other fuel costs, the overall cogeneration efficiency of the PowerWorks microturbine can be particularly high — reaching 70% use of the fuel energy consumed and even higher in some industrial applications.



Built by Ingersoll-Rand and backed by IR worldwide service

The PowerWorks microturbine continues the Ingersoll-Rand tradition of product innovation, engineering excellence, tough industrial construction, and responsible service. Under typical around-the-clock operating conditions, scheduled service is required only about once a year, and the entire system is designed for an operating life of 80,000 hours — or approximately 10 years. And with an extensive worldwide network of distributors and technicians, Ingersoll-Rand is uniquely positioned to provide complete PowerWorks application support, installation, and service.



Engineers from several IR divisions joined forces to develop and refine various PowerWorks components, subsystems, and manufacturing processes. And with a business history dating back to 1871, Ingersoll-Rand has established an enviable reputation for providing practical energy solutions and reliable customer support.

Bottom-line performance and savings are impressive

PowerWorks is the only microturbine available with this unique combination of attributes that makes it such an outstanding performer.

Energy Cost Savings

- Electricity costs reduced
- Heating costs saved
- Savings incentives accrued
- Consumption penalties avoided

Rugged System Design

- 80,000-hour life
- Low maintenance
- Indoor qualified

Friendly Operation

- Very low emissions
- Compact footprint
- Low noise level

Ingersoll-Rand Security

- Global service network
- Innovative service programs
- Remote monitoring

The PowerWorks microturbine system can be installed inside a utility room or outdoors in an enclosure. One or more systems can be used to match or offset a facility's demand for electricity and heat energy, or individual systems can be dedicated to special applications.

Many Facilities Can Profit from Cogeneration

PowerWorks cogeneration is practical and economical

While efficiently providing economical electricity to reduce the consumption of more expensive utility power, one or more PowerWorks systems installed on site can also supply all or a portion of the heat energy needed to operate many commercial and industrial facilities. Actual savings depend on the particular application and operating scenario. However, comparing cost per kilowatt-hour, PowerWorks is the least expensive microturbine to purchase, operate, and maintain over the life of the system.

PowerWorks produces energy savings for diverse applications

- Oil refineries
- Hotels and motels
- Multifamily dwellings
- Commercial greenhouses
- Ice rinks
- Athletic facilities
- Schools and colleges
- Healthcare facilities
- Big-box stores
- Shopping malls
- Commercial laundries
- Manufacturing processes
- Food markets
- Landfills
- Wastewater treatment
- Other users of electricity and heat

PowerWorks provides economical electricity plus useful heat

- Reduce base consumption
- Provide peak shaving

plus

- Hydronic space heating
- Direct space heating
- Domestic hot water
- Process hot water
- Desiccant wheel recharging
- Absorption chilling
- Dehumidification
- Process drying and curing
- Heating and preheating
- Ice melting
- Special heat applications

PowerWorks supplies energy on site where needed

The highly efficient cogeneration of two types of energy from a generating plant is only practical when the energy is produced on site where the heat is needed. Unlike electricity, which can be generated at a remote source and distributed over great distances with only small losses, heat is most economically consumed at the point of generation. The heat produced by centralized electric generating plants is commonly wasted up the smokestack. By comparison, the heat energy recovered by an on-site PowerWorks cogeneration system helps reduce the total cost of both the electricity and the heat consumed by the particular application.

In addition to these typical commercial and industrial facility uses of cogenerated electricity and hot water, PowerWorks can provide thermal energy for space heating and industrial processes.

Energy consumers and the environment both benefit

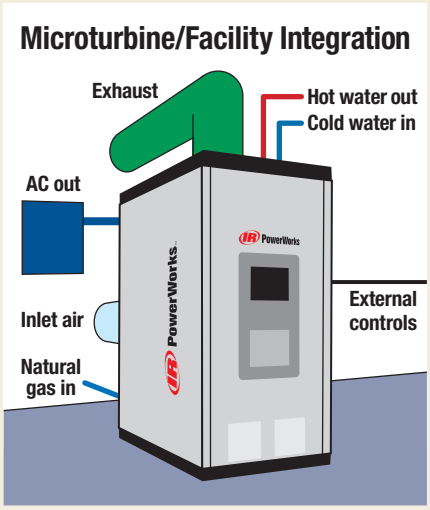
By providing new on-site electric capacity without requiring new transmission lines or additional central power plants, PowerWorks is helping both energy consumers and the environment. The PowerWorks microturbine system is meeting the growing global demand for reliable commercial/industrial power while helping to relieve congestion of the transmission and distribution networks. PowerWorks even further helps the environment when operating on waste fuels and landfill gases or when abating odors. And since PowerWorks is relatively small and quiet with a clean exhaust, the microturbine is easier to place — in a facility utility room or outdoors in an enclosure.

Many factors contribute to big energy savings

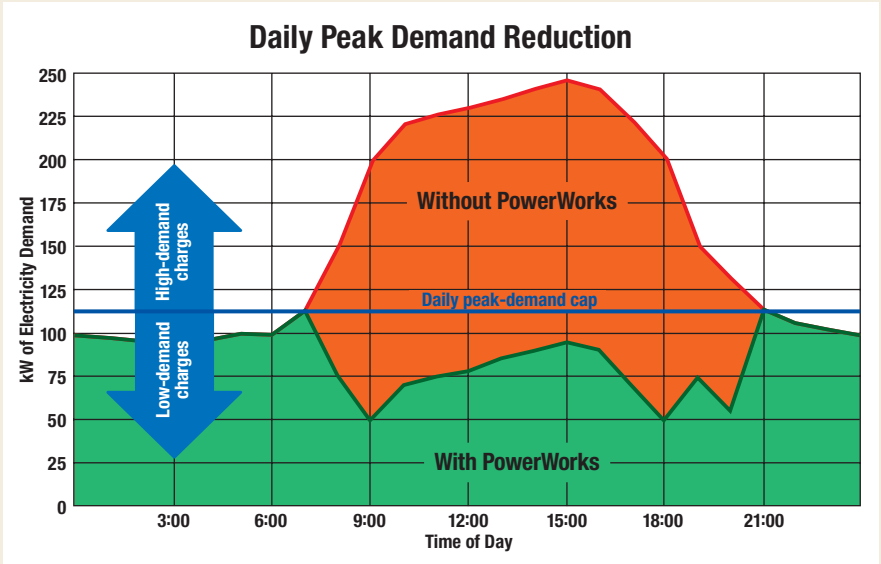
A calculation of the actual savings and benefits you can expect from PowerWorks depends on several factors, which include the cost of installing, operating, and maintaining the microturbine as well as opportunities for energy savings specific to applications and operating locations. For example, in some regions the value of recovered heat energy may offset the cost of fuel for heating and air conditioning. In other locations, the building load profile may accommodate peak-shaving savings on a daily basis.

The *spark spread* determines bottom-line energy costs

The most significant factor for achieving big energy savings is the *spark spread*. Basically, this is the difference or "spread" between the cost of buying electricity from the power grid compared to the cost of the fuel used when generating the same kWh of electricity on site. The greater the spark spread, the bigger the savings, which is the key to determining whether an on-site microturbine generating system will deliver a payback sufficient to make a difference in bottom-line energy costs. For cogeneration applications, the higher the combined efficiency of the system, the shorter the payback period, and the greater the ongoing savings.



PowerWorks is designed for conventional integration with a facility's electrical and hot-water distribution systems. Natural gas and inlet air are brought to the microturbine, and the extremely clean exhaust is vented outdoors.



PowerWorks can significantly reduce the daily demand peak for utility-grid power to minimize electric consumption during high peak tariffs, which also avoids demand ratchet charges.

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The 70 kW Microturbine Cogeneration System

Small cabinet footprint
- Length 69" (175 cm)
- Width 42" (107 cm)

Low emissions exceed stringent standards
- <9 ppmv NOx and CO

Designed for indoor operation
- Meets all applicable gas-equipment codes and standards

Rugged and reliable microturbine engine
- Commercial/industrial-grade design
- Robust military-grade recuperator

Integrated waste-heat recovery system
- Controllable output level

Fueled by natural gas
- Integrated fuel-gas booster

Long-life system with low maintenance
- 80,000-hour system life
- 8,000-hour maintenance cycle

Proven generator design
- Widely accepted technology

High-efficiency energy output
- Electricity – 70 kW nominal
- Heat – 100,000 to 400,000 BTU/hr

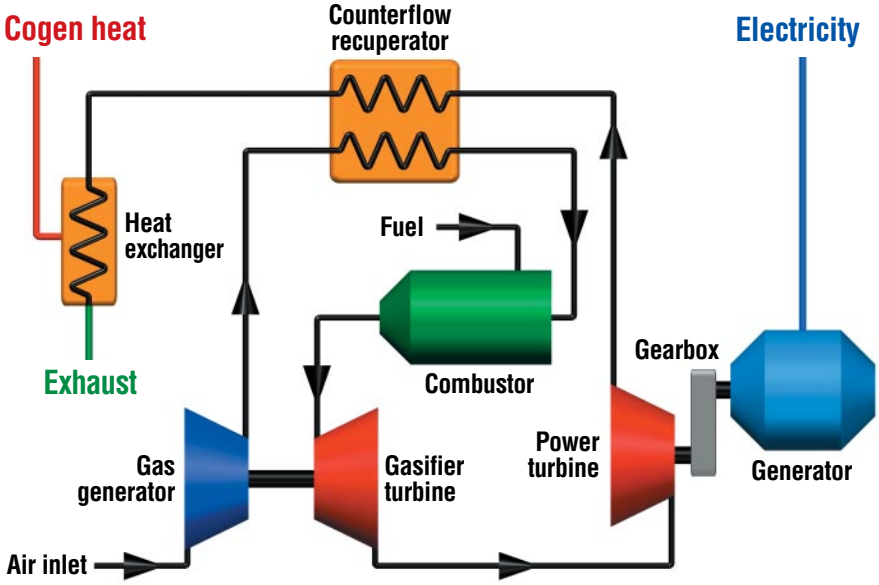
Sound-attenuating enclosure
- Qualified for indoor use

The PowerWorks cycle

Compressed inlet air enters the recuperator and is preheated with heat captured from the microturbine exhaust. The heated air enters the combustor where it mixes with fuel and is raised to an even higher temperature.

This hot, pressurized gas drives the turbine that powers the compressor and also drives a second turbine, which provides mechanical-shaft power to operate the electric generator.

The exhaust gas passes through the recuperator and then enters the cogeneration heat exchanger to extract much of the remaining energy as hot water. The relatively cool and clean exhaust is then vented into the environment.



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The PowerWorks line of products was developed with the assistance of Southern California Gas Company, The Gas Research Institute, and The New York Gas Group.

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